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Reconstruction Software Progress Report

Jim Musser

Caltech

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Primary Activities

- Although work continues on activities such as track swimming, alignment, etc, work reported at this and other recent reconstruction group meetings centered on....

- Development of calibration framework for offline software
- Demuxing
- Tuning on Far Detector Data
- Starting to respond to input from users

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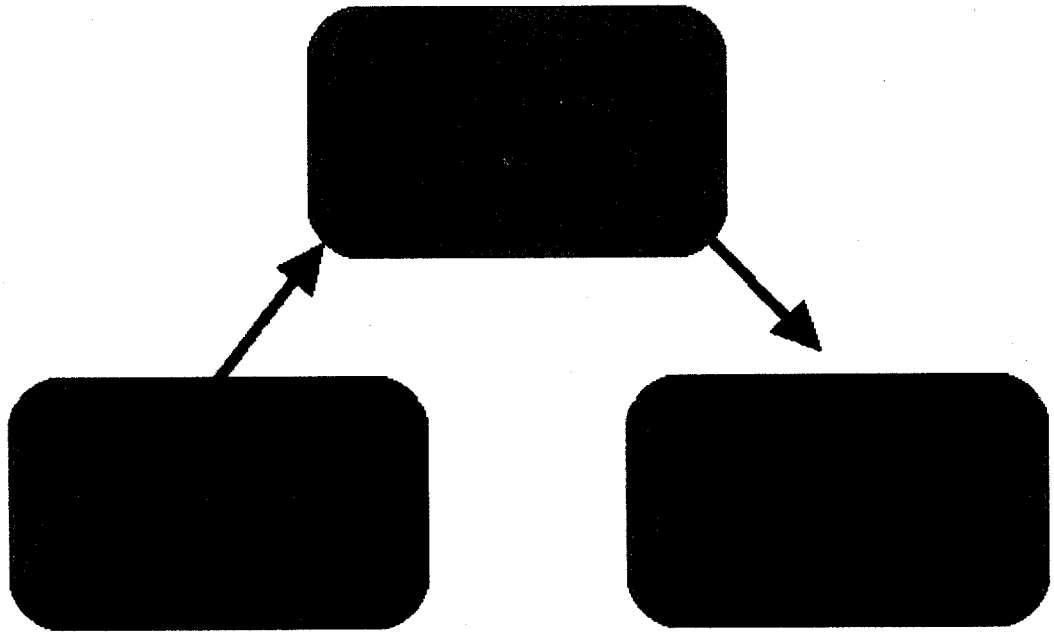
Calibration Framework



3 Components

Calibration Makers (basic algorithms to start were developed by CalDet group - need to be ported to offline for production.)

Calibration Database Tables

Calibration Interface

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Calibration Framework

- Active Participants
  - Ryan N., Phil A., Leon M.., Roy L., Chris S., Core Group, me
- At the time of the Oct. meeting, CalDet calibration makers existed, as did basic support for LI calibration (although the hooks into the offline were not in place)
- At that meeting we set a goal of developing a complete far detector and CalDet calibration framework for the offline by this meeting, with ported calibration makers to be the next step.
  - Didn't quite meet this goal, but we're close.

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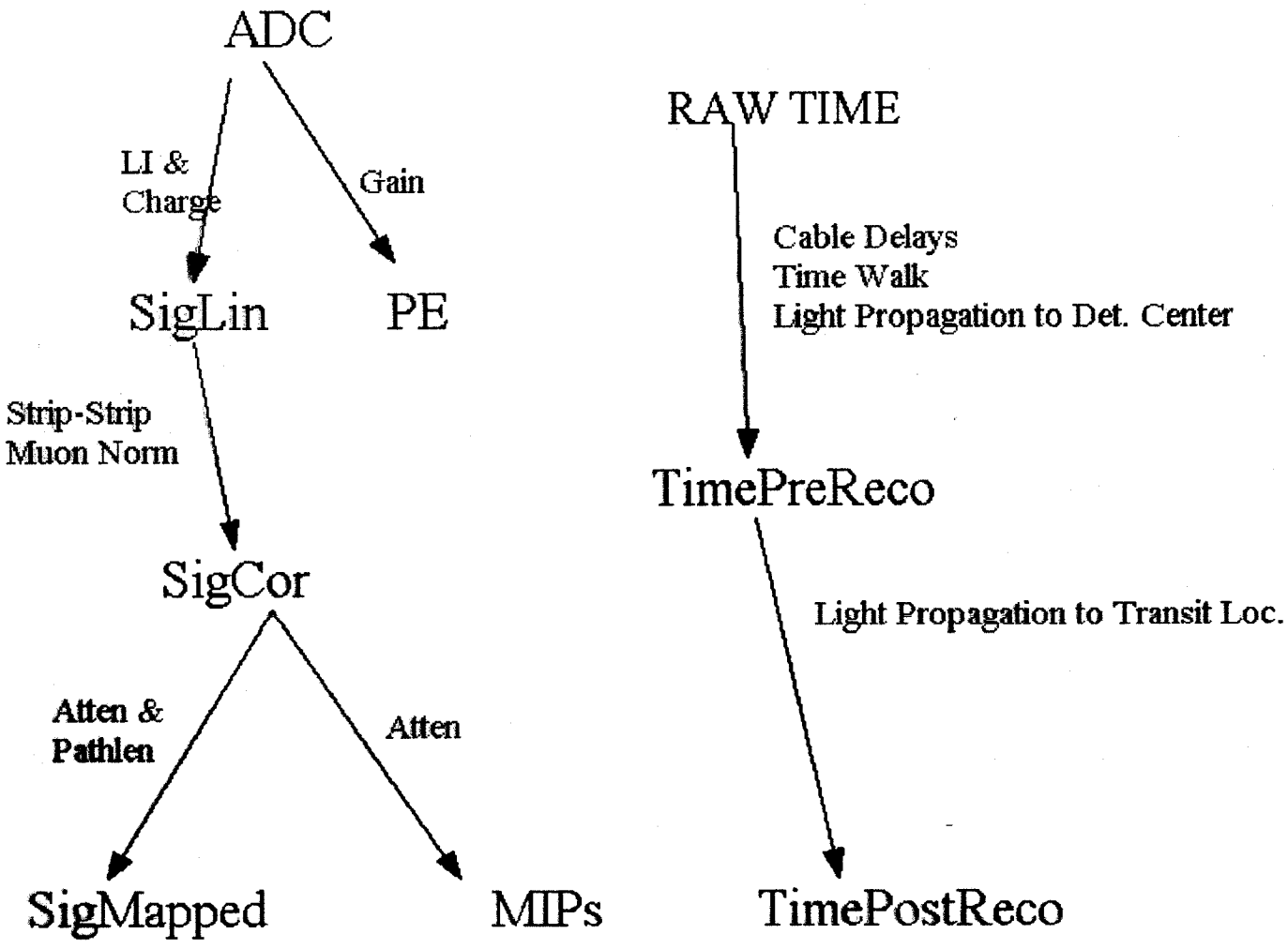
Calibration Flow



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Calibration Table Status

- Tables needed in the short term have been defined. (missing are near detector electronics calibration tables, etc)

- Scripts written to load & initialize tables in user dB.

- Indexing needs some core group help.

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Existing Calibrations

- Existing calibration data includes
  - CalDet gains
  - CalDet muon normalization
  - Module mapper data

  - CalDet LI summaries will be produced starting in two weeks (Phil A.)

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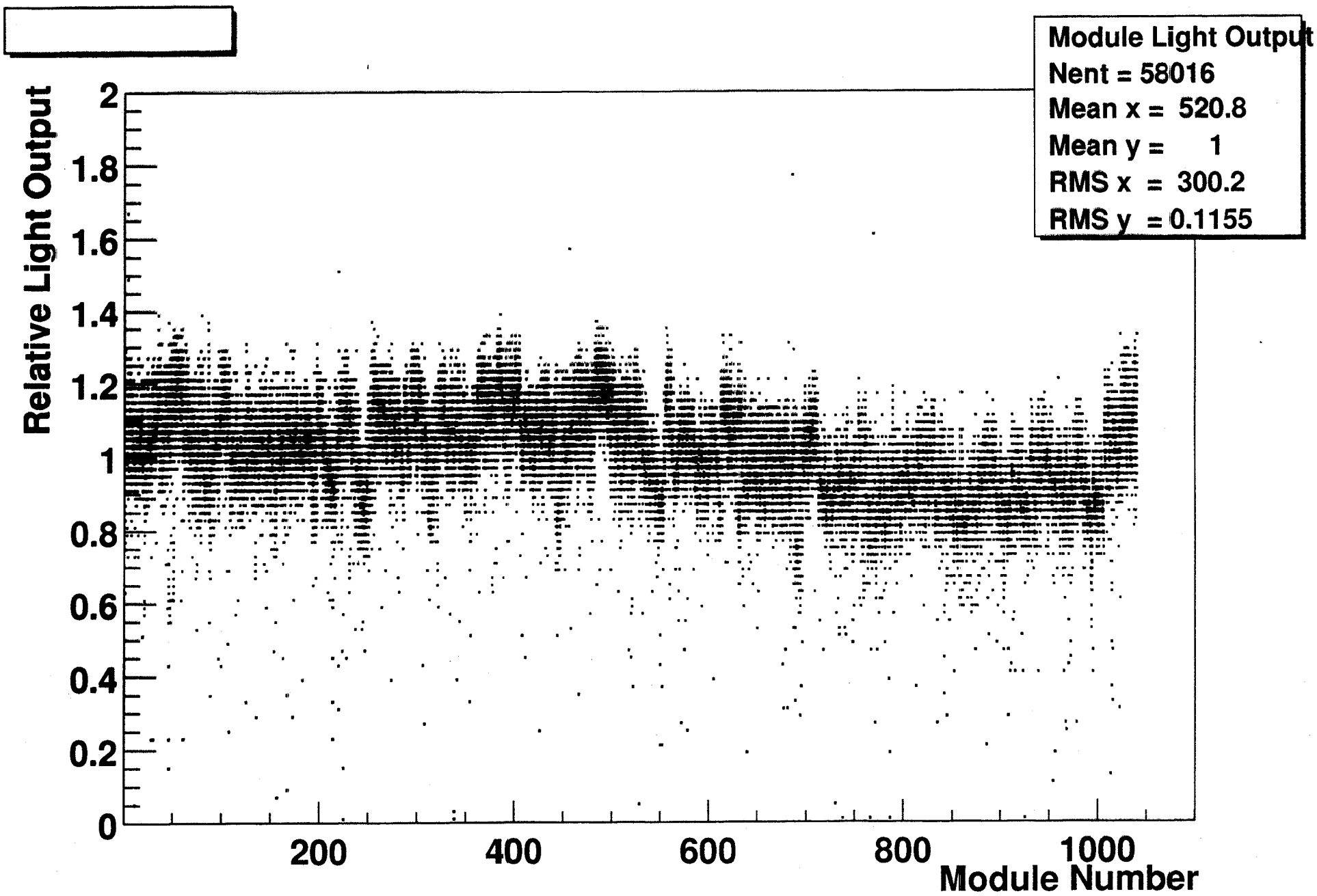
Mapper Data

- Leon has made available parameterized fits to the mapper data, which will be used as the initial attenuation length correction.

- Still to do - build table of module-ID to detector location..

Mualem


Module Light Output
Nent = 58016
Mean x = 520.8
Mean y = 1
RMS x = 300.2
RMS y = 0.1155
Relative Light Output
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
200
400
600
800
1000
Module Number

Precision Mapper Table Status

- Table created at UMN Web site.
- Available from: http://www.hep.umn.edu/minos/mapper/db/
- Filled with ~1000 modules.
- **~200MB for 1/4 of detector!**
- Ready for conversion to DBI?!?

Field	Type	Null	Key	Default	Extra
TEST_ID	int(6)		PRI	NULL	auto_increment
FACTORY	char(3)	YES		NULL	
MODULE_ID	varchar(10)				
TYPE	char(1)				
NSTRIPS	int(2)	YES		NULL	
NSIDES	int(1)	YES		NULL	
NSCANS	int(4)	YES		NULL	
YSTART	float(10,5)	YES		NULL	
YSTEP	float(10,5)	YES		NULL	
F1LENGTH	float(10,5)	YES		NULL	
F2LENGTH	float(10,5)	YES		NULL	
MAPPER_ID	char(3)	YES		NULL	
MAP_DATE	datetime	YES		NULL	
LENGTH	int(3)	YES		NULL	
ANA_VERSION	varchar(10)	YES		NULL	
CAL	float(8,4)	YES		NULL	

Field	Type	Null	Key	Default	Extra
TEST_ID	int(6)	YES	MUL	NULL	
STRIPN	int(3)	YES	MUL	NULL	
YPOS	float(10,5)	YES	MUL	NULL	
SIDE	int(1)	YES	MUL	NULL	
LIGHT_OUTPUT	float(10,5)	YES		NULL	
DELTA_LO	float(10,5)	YES		NULL	
LOWER_X	float(10,5)	YES		NULL	
DELTA_LX	float(10,5)	YES		NULL	
UPPER_X	float(10,5)	YES		NULL	
DELTA_UX	float(10,5)	YES		NULL	

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Calibration Options

- Adc to PE
  - based on fits to 1 PE dist. (default)
  - based on mid-light level widths. (not yet)
  - based on PMT test stand data (not yet)
- Linearity Correction
  - linear interpolation (default)
  - quadratic interpolation (not yet)
- Strip to strip norm
  - based on fit to μ landau dist (default)
  - based on averages of landau dist. (not yet)
- Atten Correction
  - fit to mapper data (default)
  - use 'raw' mapper data (not yet)
  - use fit to muon data (not yet)

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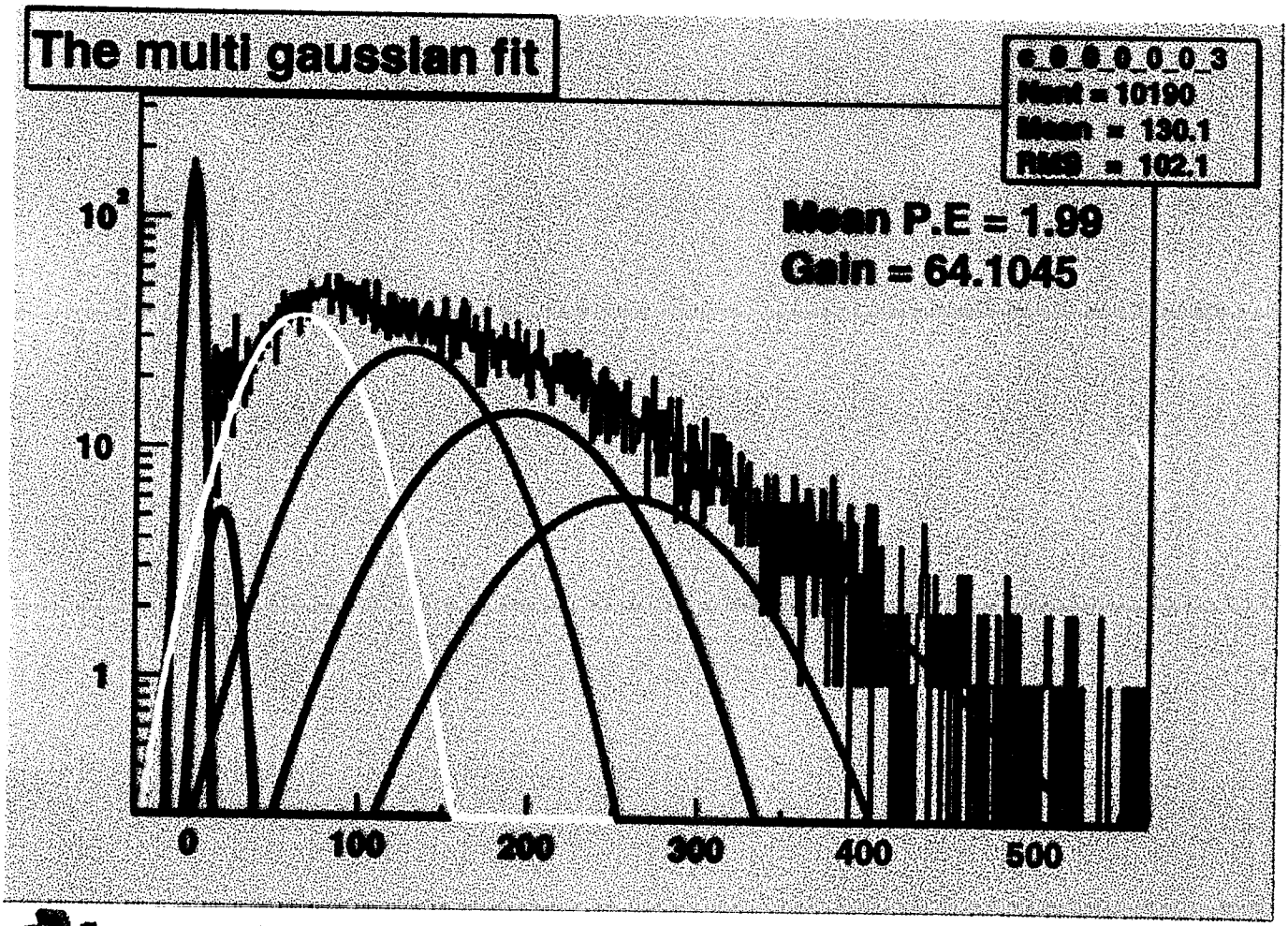
Calibration Makers

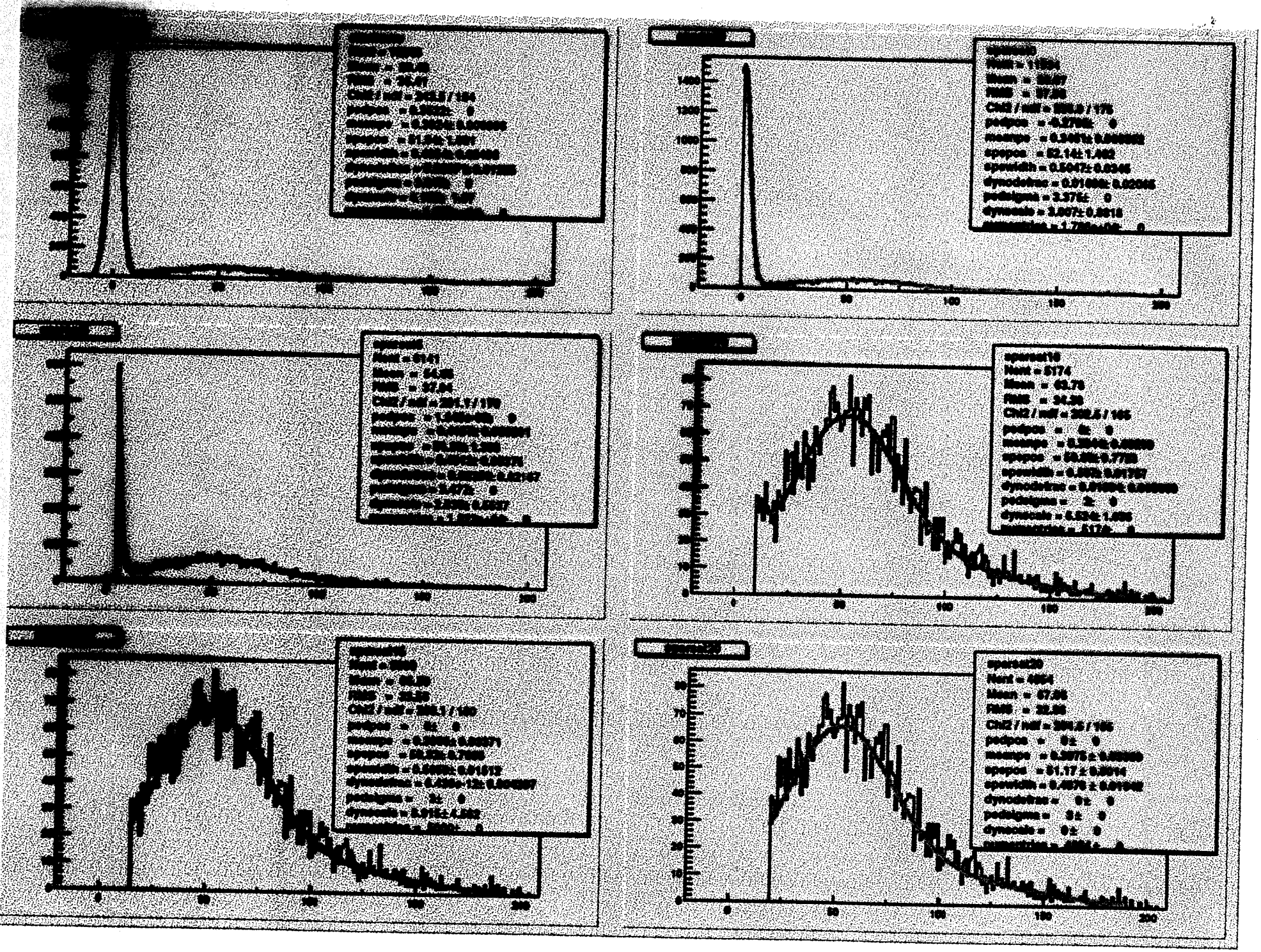
- All exist as stand alone programs - need to be ported into the offline framework. This effort is planned for the coming 1-2 months.
- Careful thought needs to be given to calibration constant validation as these turn into production jobs.

- ADC to PE (Ryan Nichol)
  - Issues in converting to general use include ability to use sparsified data, finding a single flasher setting which works for all channels.
- Mapper fits (Leon) (exists)
- Muon normalization
  - Issues for converting to general use include use on low statistics data samples.

Gain

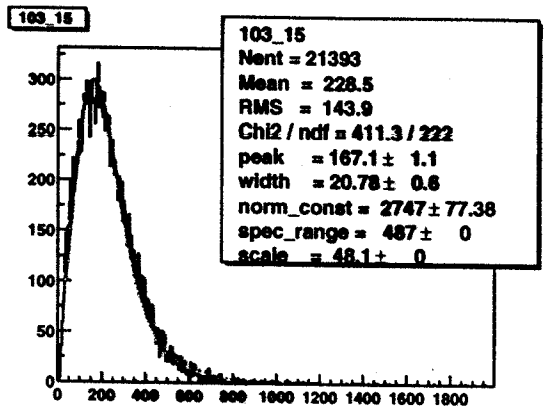
- Can also use the LI system to determine the number of ADCs per photo-electron.
  - **This was done for each of the channels in the detector.**
- There were two methods used to calculate the gain:
  - Fitting a multi-gaussian fit to low light level spectra.
  - The mean over sigma method for medium to high light levels.
- An example of the fit method is shown below.

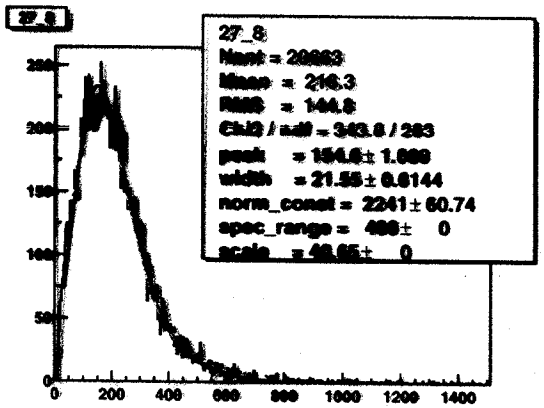


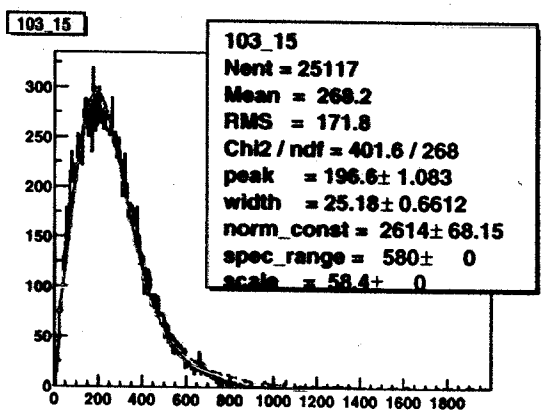


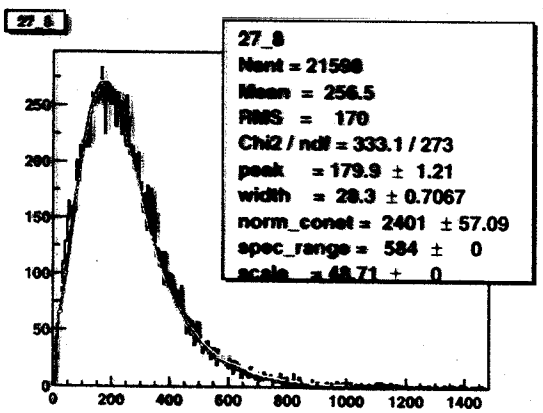
Examples of Fits

Histograms are rebinned and fit using the function above. Examples:









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Near Term Calibration Task List

- Allow db table indexing on strip ends
  - Robert H.
- load CalDet calibrations, generate LI summaries
  - Ryan Nichol, Phil A.
- Map module ID to detector location
  - ?
- Hooks for post-reco calibration in reco framework.
  - Roy Lee
- Develop production calibration makers
  - Ryan, Chris, Phil

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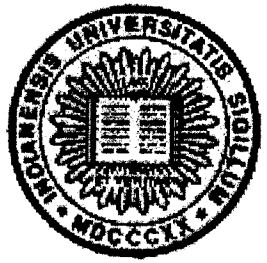
Demuxing

- Progress by Brian since last meeting has been substantial, but we still have a ways to go….

- Input from more people scanning events and passing anomalies back to Brian would be very helpful.

"Missing" Events - Before



- It was noticed at the last reconstruction phone meeting that a large fraction of events were demuxed because the algorithm couldn't find a vertex
- I looked into the events and found that most of the events where the algorithm failed had signal from only 1 side of the detector
  - ~ 2/3 of the one sided events were followed by one sided events on the opposite side
  - → timing problem; found there was an ~80 ns difference between the two crates

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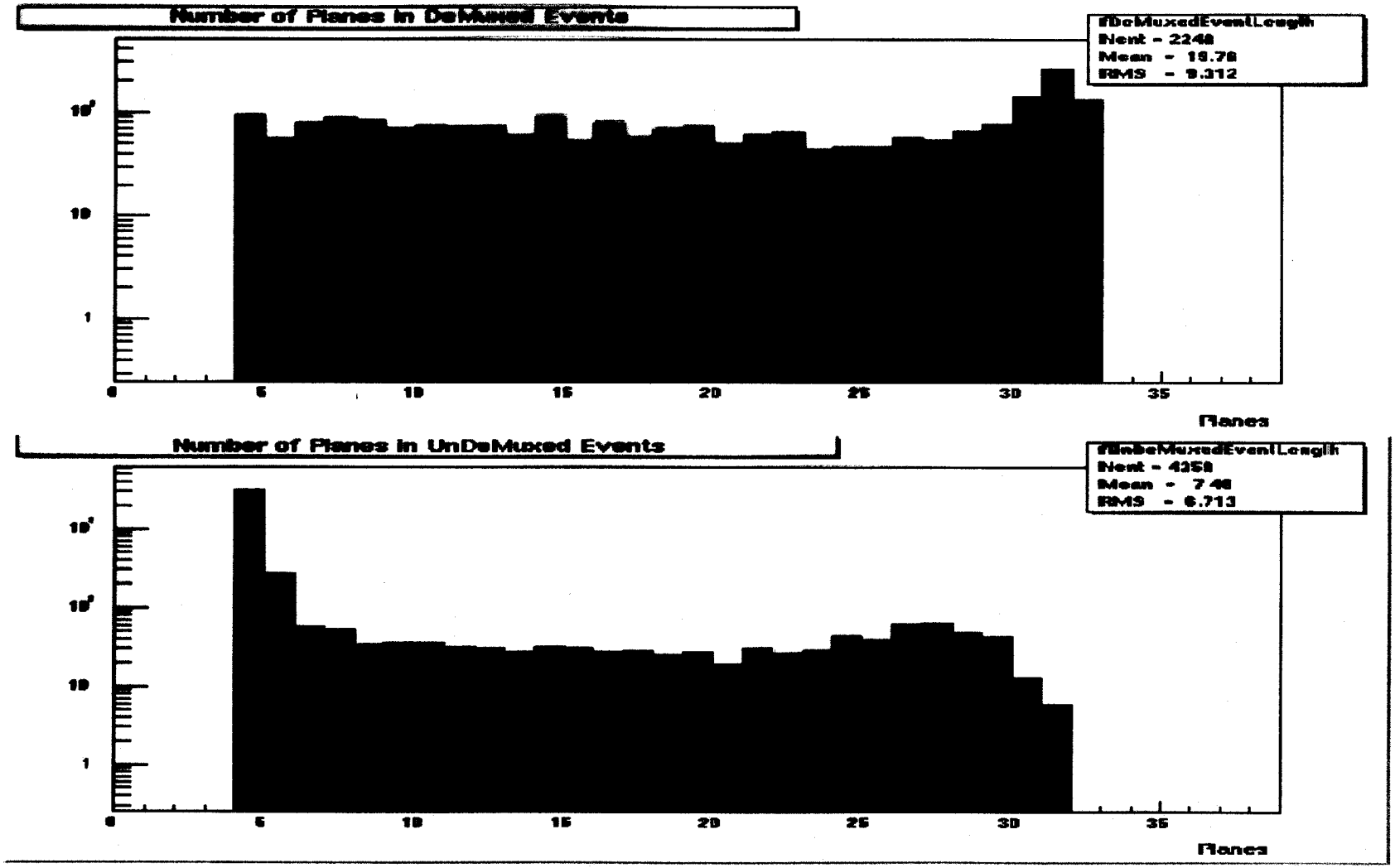
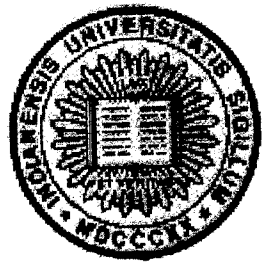
Event Length Plots

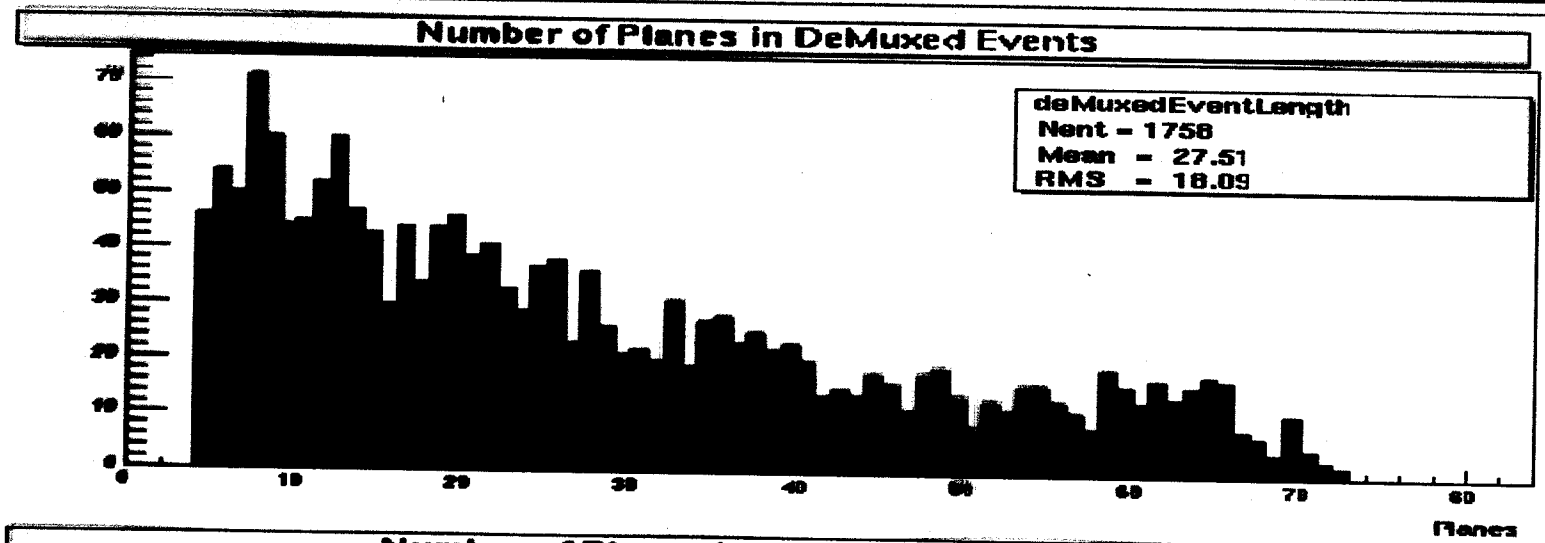


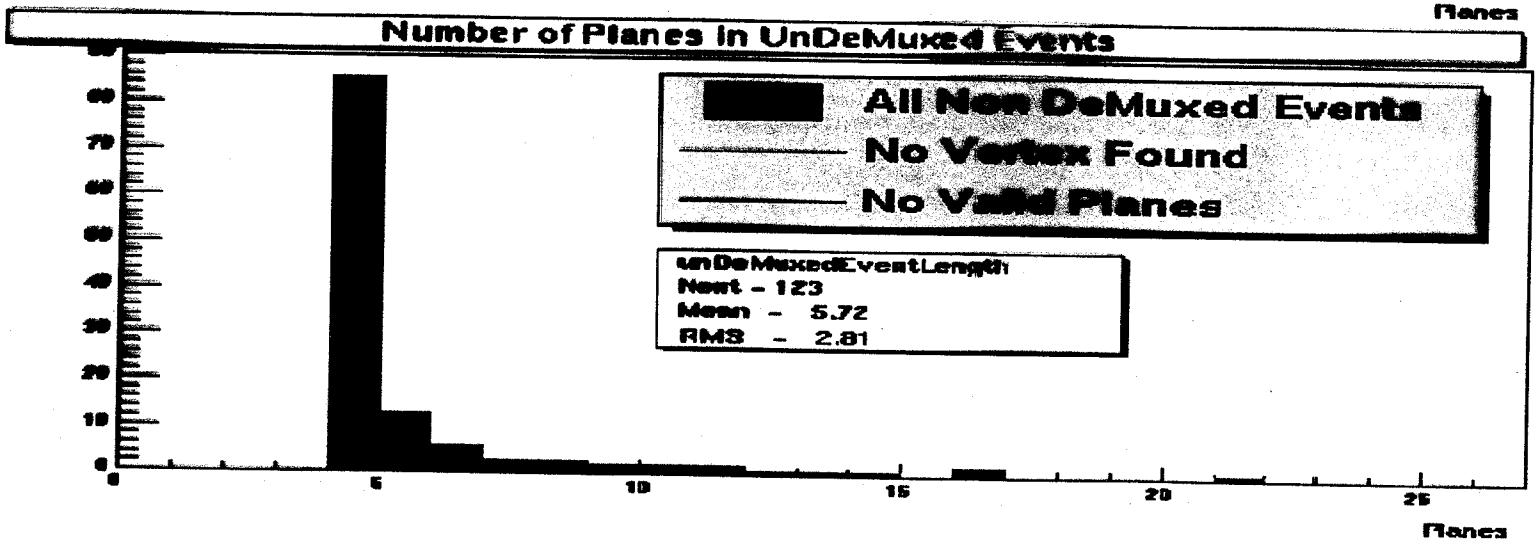
"Missing" Events - After

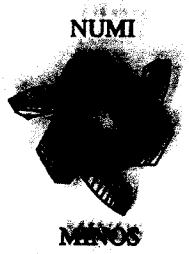


- Crates now appear to be within 10 – 20 ns of each other
- Majority of events without a vertex are still in the 4 – 6 plane range. Most planes in these events have only 1 digit
- Longer events may be result of the runs having a large dynode threshold set (only way to keep the DAQ from falling over dead within a second).

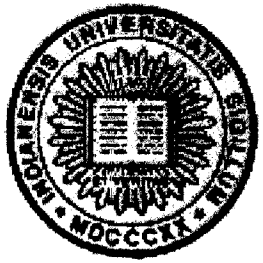
Event Length Plots



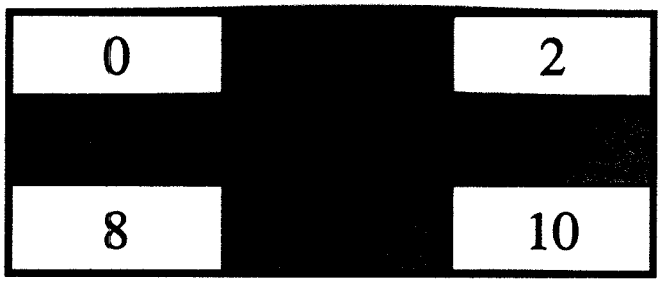




Finding XTalk Digits



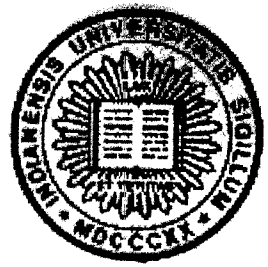
- **We check to see if a digit is from cross talk by looking for signal to be on any of the non-diagonal nearest neighbor pixels of the digit's pixel of origin. For example,**



  - **We summed the total signal from the 4 nearest neighbors and found what fraction of that total the digit's charge represented.**

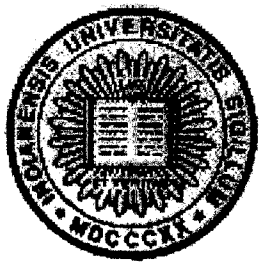
$$f = S_5 / (S_1 + S_4 + S_6 + S_9)$$

Changes to the Package



- New vertex finding algorithm – take the vertex to be the first plane in a set of 5 with 3/5 valid planes
- NavMasks can now be used to mark possible xtalk digits.
  - Use of NavMasks controlled in .jcm file through the HandleCommand() method; can set the xtalk level from this method too
  - Use digits not labeled as xtalk to determine plane type, best hypotheses
  - All digits are set to determined hypothesis once a solution is found

Changes, Continued



- I did some code optimization following the October meeting and the DeMux-er runs ~3-4x faster now
- Can now use Roy's track fitter for the DigitsAlongTrack test of the algorithm.
- I've also used it to look at the zenith/azimuthal angle and RA/Dec distributions of the muons

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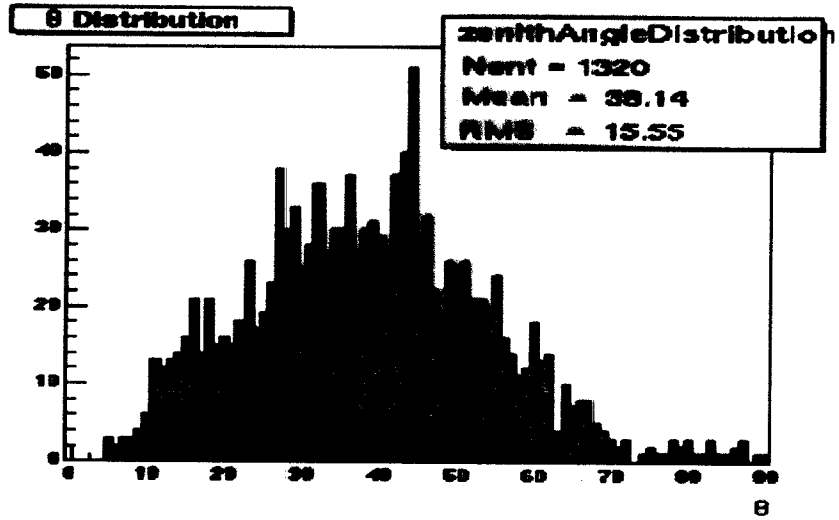
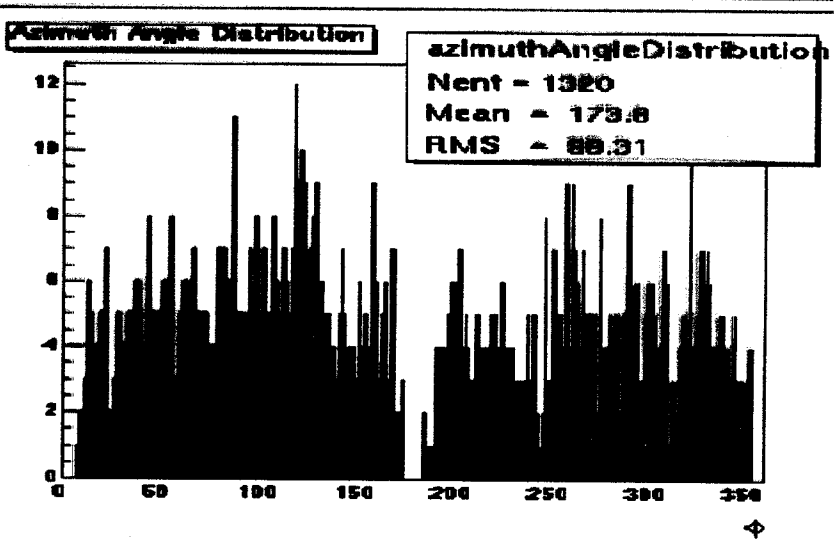
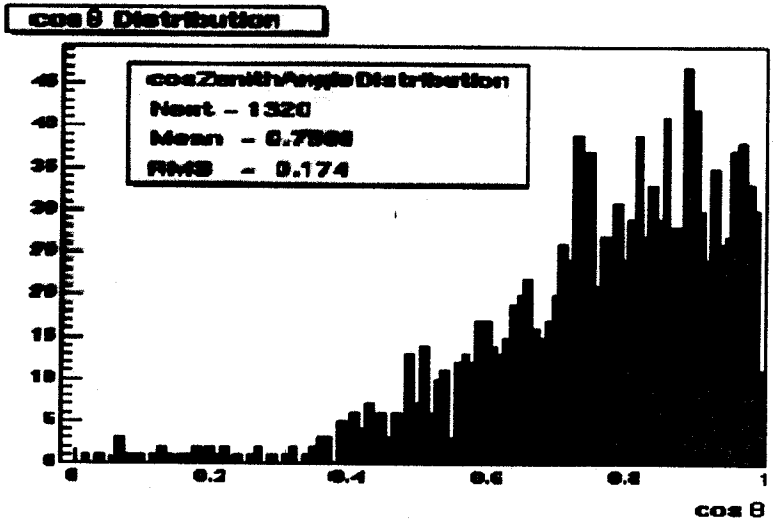
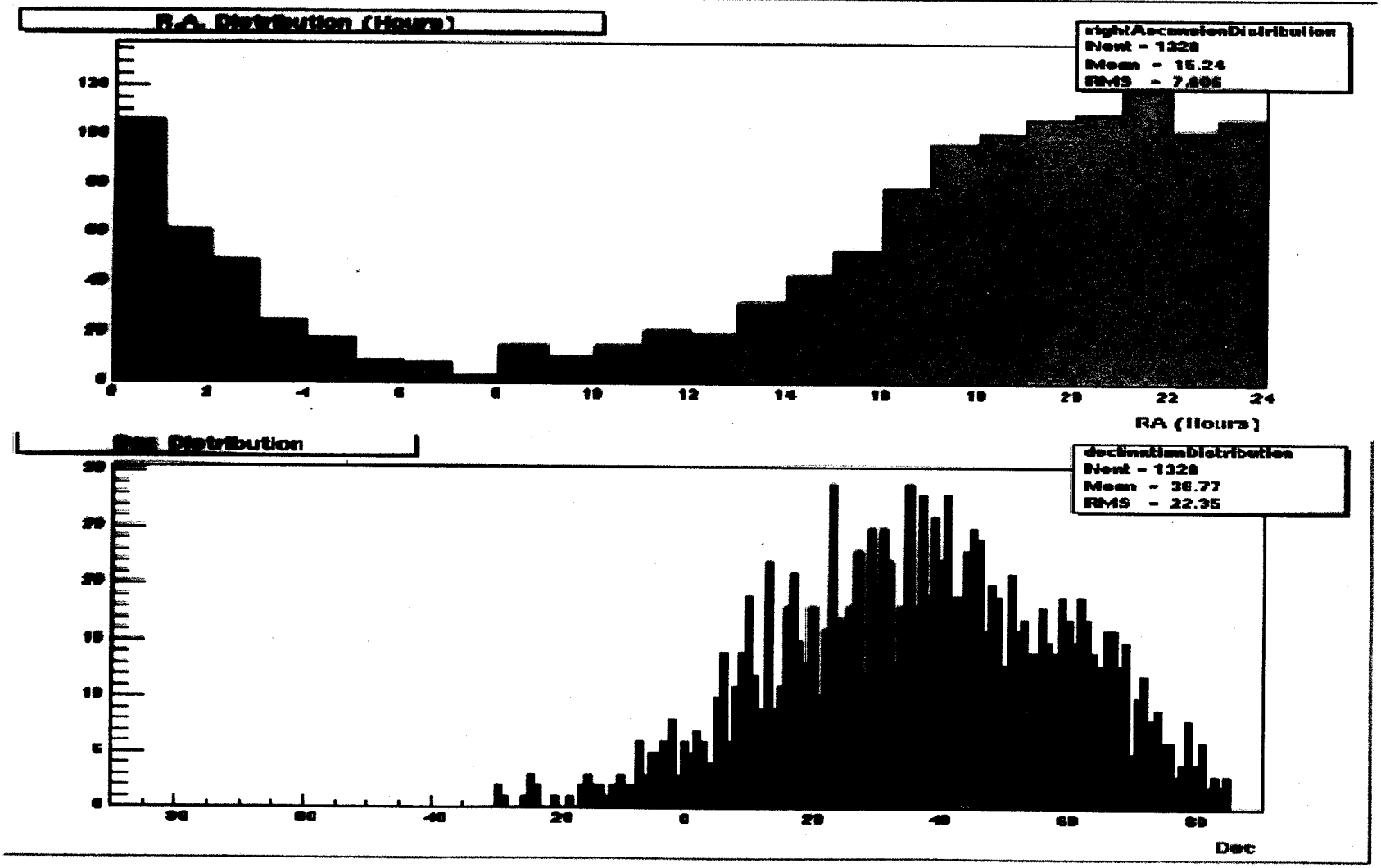
Angle Distributions







RA and Dec Distributions



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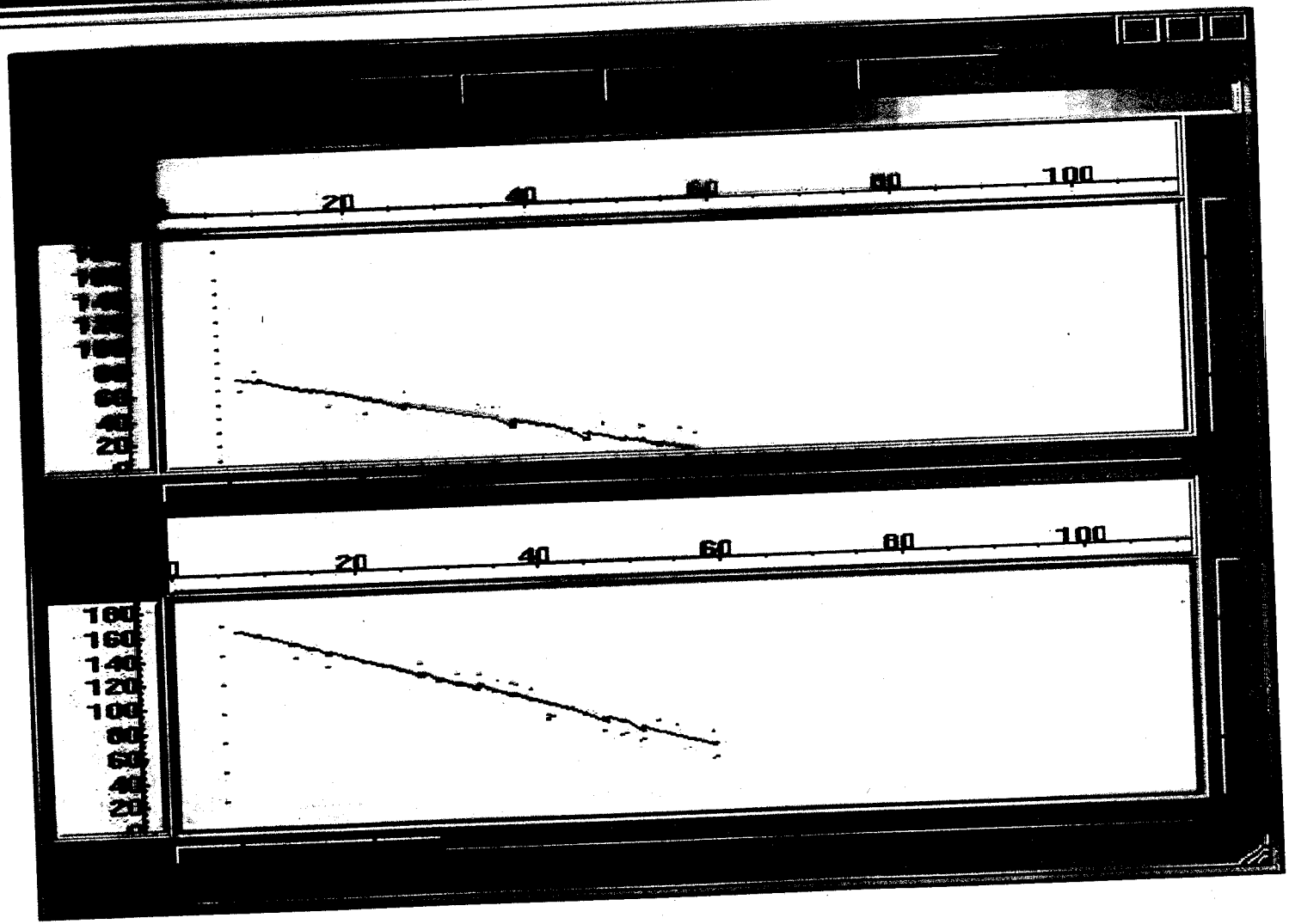
Example Events



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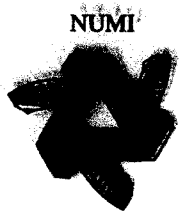

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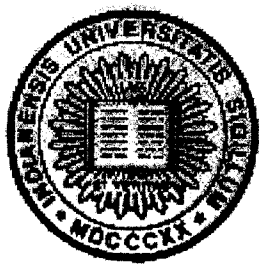
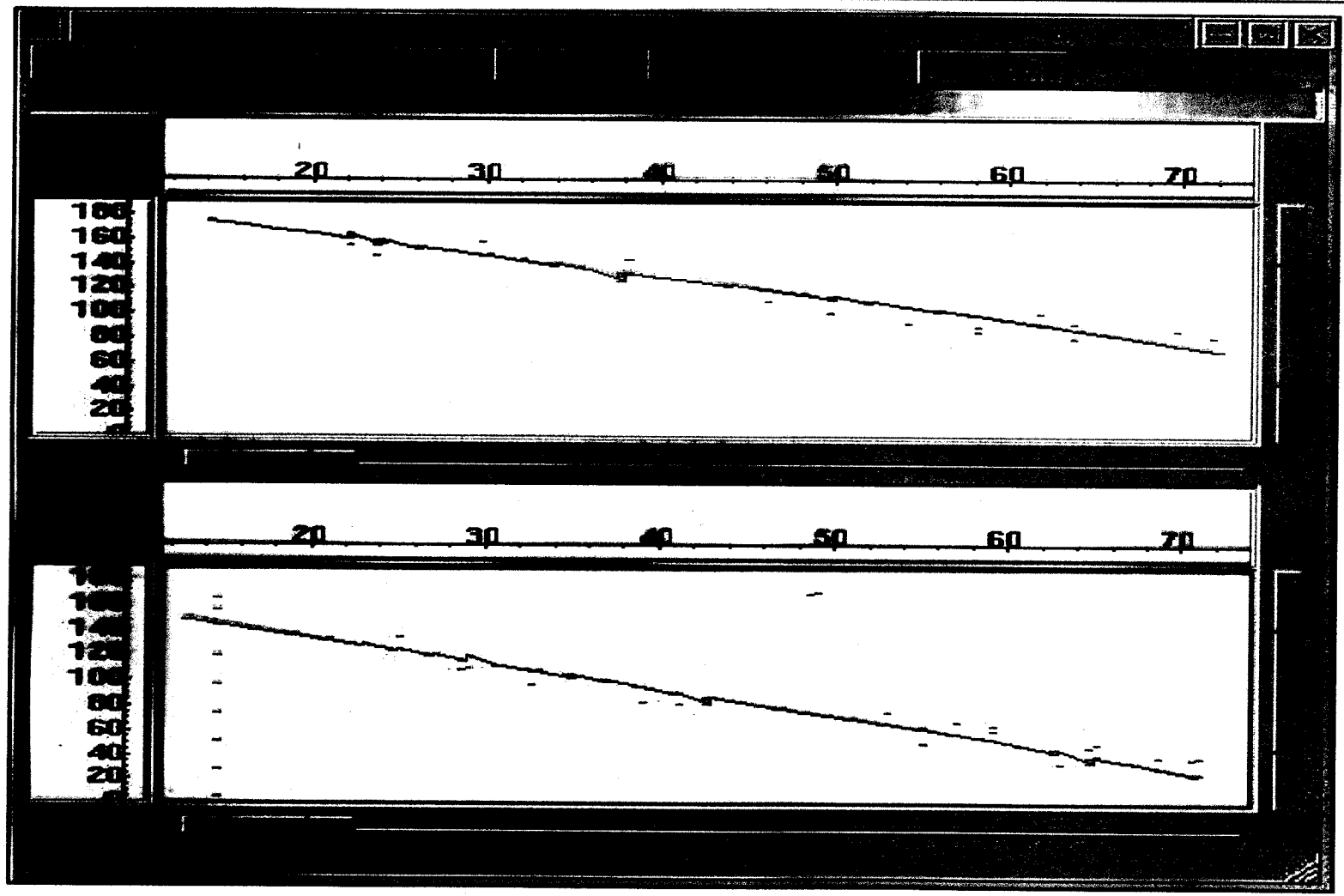
Example Events





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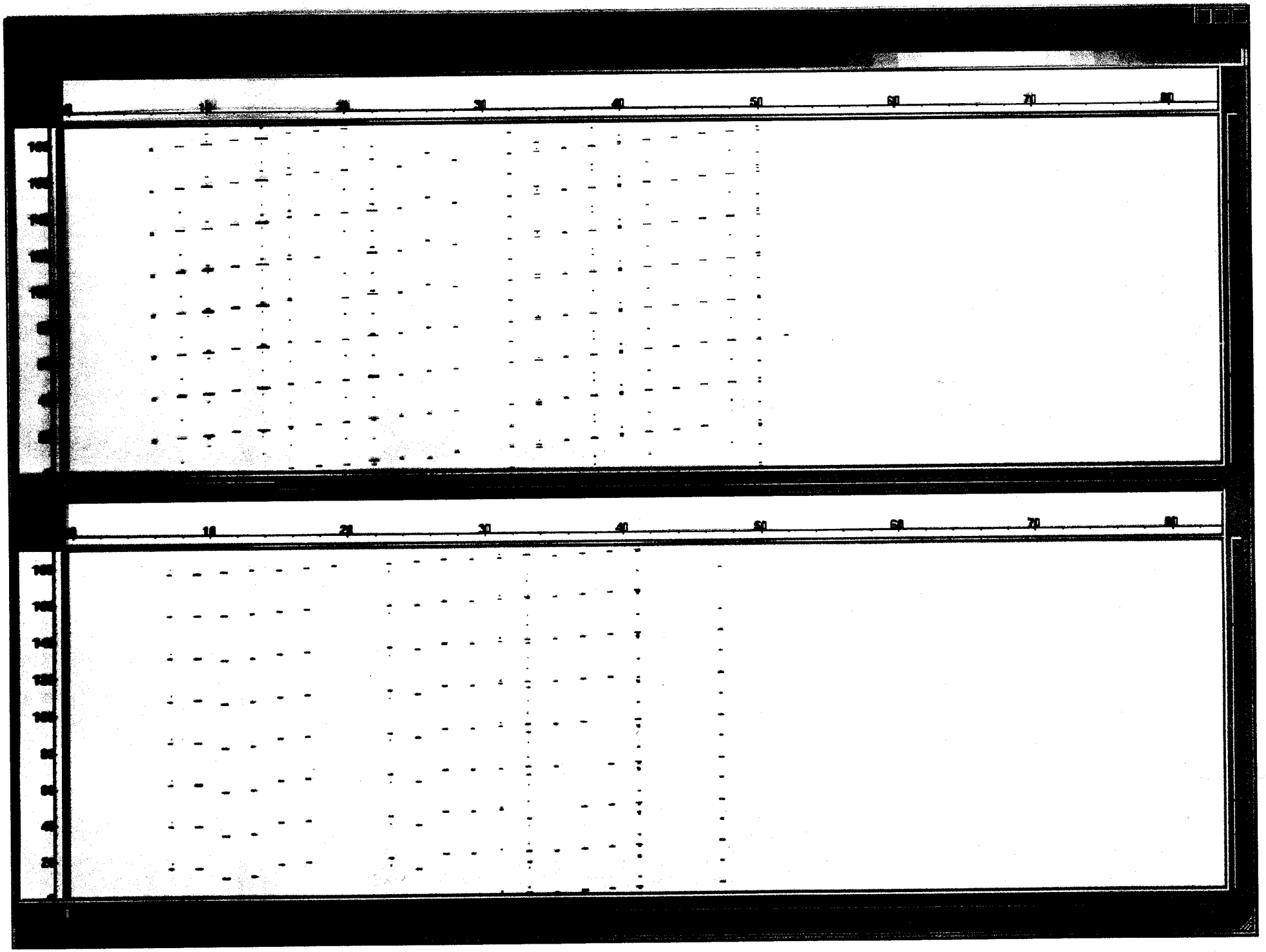
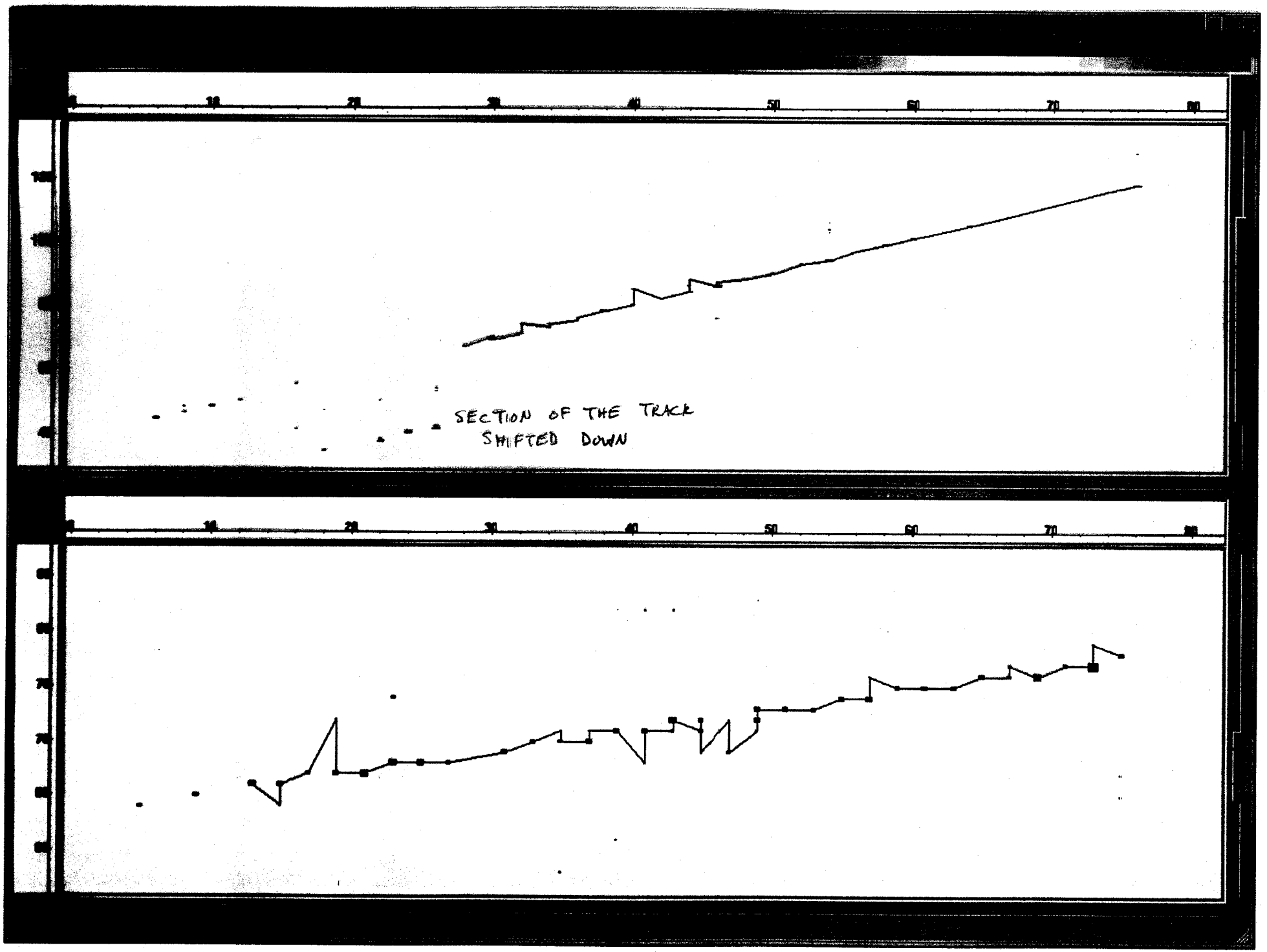
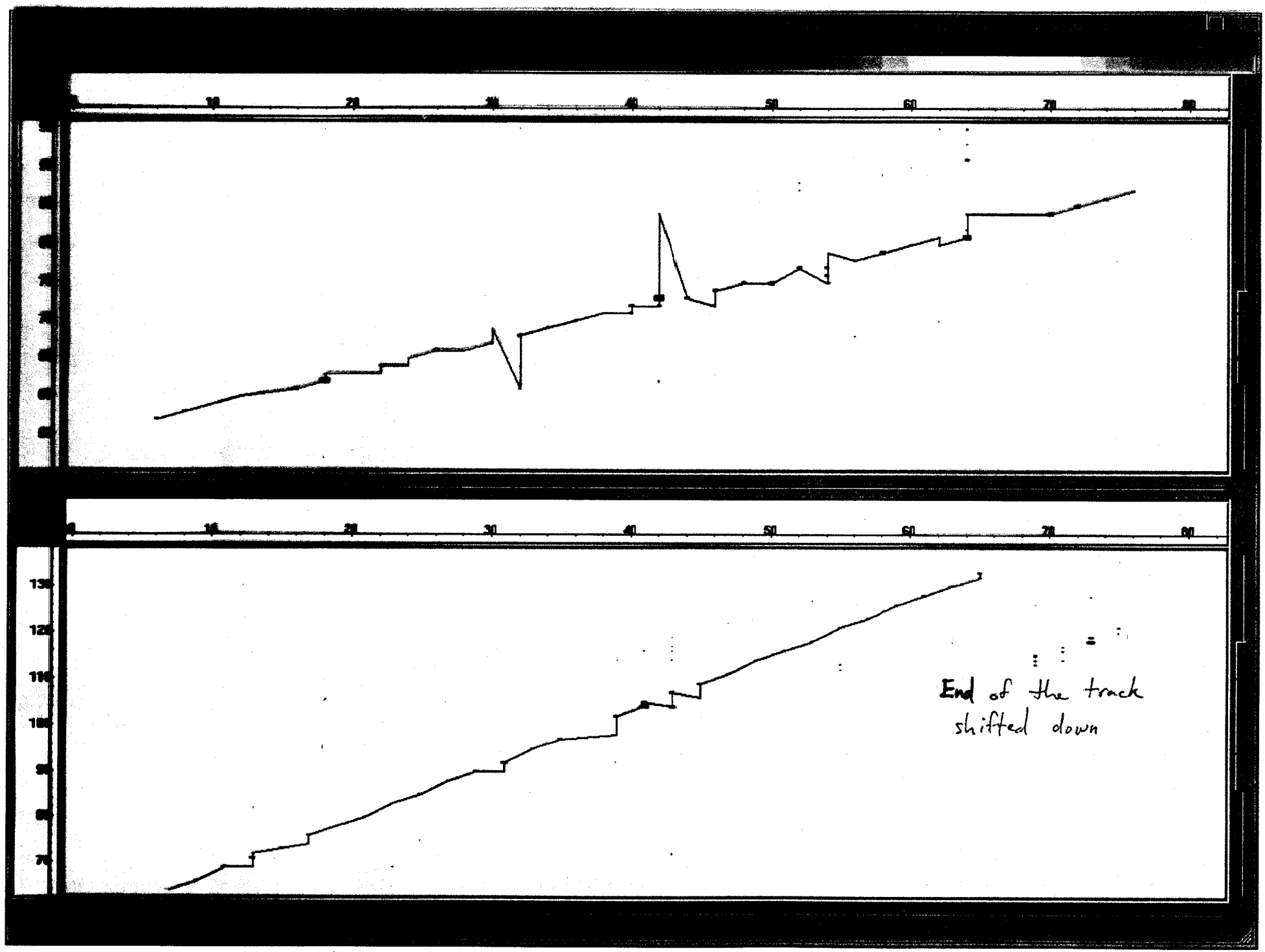



SECTION OF THE TRACK
SHIFTED DOWN


End of the track
shifted down

SNARL 42